IMPLAN BASED IMPACT MODELING FOR COMMERICAL FISHERIES ON FLORIDA'S EAST COAST: ALTERNATIVE APPROACHES AND RECOMMENDATIONS

by

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INTRODUCTION

This paper reports the results of a study to evaluate alternative approaches to developing an input-output modeling capability that will allow the National Marine Fisheries Service to complete economic impact studies associated with specific fishery regulatory changes.[1] The study is based on the potential use of the IMPLAN (IMpact Analysis for PLANing) Professional ® software modeling package and associated databases.[2] Specific objectives include:

a. describing IMPLAN Professional (IMPLAN) software and databases with regard to existing fishery related sectors,

b. evaluating existing IMPLAN sectors in the context of commercial fishing on Florida's east coast (primarily value of landings by species and county, types of fishing gear employed, and the nature of production expenditures, relationships between commercial fishing and the retail, wholesale, and processing sectors, and the size and type of fishing by sub-region of the state),

c. recommending adjustments to standard IMPLAN models with respect to the number and nature of fishing sectors and the need for state and/or sub-state models, data requirements to support adjustments, and an evaluation of existing data, and providing recommendations with regard to accomplishing the recommended approach.

Following sections provide a descriptive overview of the fishery along Florida's east coast followed by an overview of the IMPLAN regional modeling system and specific applications to estimating fishery impacts. A final section presents conclusions and recommendations.

THE FLORIDA EAST COAST FISHERY: AN OVERVIEW

To develop guidelines for modifying standard IMPLAN models to more accurately estimate economic impacts of changes in Florida's east-coast commercial fishing industry, it is important to review the industry, how fishing technology varies among different segments, and how the industry is geographically distributed within the State. Industry sectors may be defined based on species harvested and/or type of fishing gear used. Further, any analysis and definition of sectors may treat the entire east coast as one

[1] Work on the project was funded by a grant from the National Marine Fisheries Services, University of Florida Project 03060952.
[2] MIG, Inc., IMPLAN Professional 2.0: User's Guide, Version 2.0. (http://www.implan.com).

economic area or focus on sub-regions along the coast. In either case the specification of sectors and/or regions should reflect the nature of the fishing industry and the realities of defining those sectors within the context of functional economic regions.

Saltwater commercial landings along Florida's east coast have declined since 1984, when they peaked at 89.2 million pounds. Landings for 2002 came in at a historical low of 21.6 million pounds (Figure 1). The value of these 2002 landings in nominal terms was also the lowest since 1979. The average ex-vessel price for east-coast landings has been relatively stable since 1999, fluctuating by only 3 to 5 cents above or below \$1.60 per pound on an annual average basis.[3]

Geographically, there is considerable variation in the volume and value of landings along Florida's east coast (Figure 2). For the five years from 1998 to 2002, the total value of landings ranged from a high of \$71.2 million for Brevard County, to a low of \$93.1 thousand for Flagler County. The order of Counties along the horizontal axis in Figure 2 is from north to south along Florida's east coast, with Nassau County being the northern-most and Miami-Dade being southern-most. Three sub-regions of fishing activity are suggested by this graphic, with Flagler county being a dividing point between northern and central sub-regions, and central and southern sub-regions being divided at the border between St. Lucie and Martin counties. These three regions would then consist of North: Nassau, Duval and St. Johns; Central: Flagler, Volusia, Brevard, Indian River, St. Lucie; and South: Martin, Palm Beach, Broward and Miami-Dade. For later reference, these three regions correspond to Department of Commerce, Bureau of Economic Analysis (BEA) "Economic Areas". A map showing these areas is provided in Figure 3.

There is also geographic variation of targeted species groups up and down the coast. Revenues from shrimp landings dominate the northern and central sub-regions of the east coast (Figure 4). Landings of invertebrate and fin-fish are greater in the central division of the coast between Volusia and Indian River Counties. Miami-Dade County and the southern end of the study area has the highest diversity of catch among the four groups of species.

In Figure 5, the 5-year total value of different fin-fish species landings on the east coast is shown in decreasing order of magnitude. King Mackerel is the most economically important individual species for this coast, followed by Swordfish, both with landings valued at more than \$16 million. Within the invertebrate class of marine species, the 5-year value of Blue Crab landings exceeded \$18 million between 1998 and 2002, followed by Spiny Lobster and Hard Middleneck Clams (Figure 6). The 5-year value of different types of shrimp are shown in Figure 7. White Shrimp is the most valuable species harvested on the east coast, with the value of landings between 1998 and 2002 exceeding \$47 million.

[3] Data on volume and ex-vessel value of commercial fish landings by species, gear type and county were obtained from Steve Brown with the Florida Marine Research Institute, of the Florida Fish and Wildlife Conservation Commission, 100 8th Avenue SE, St. Petersburg, Florida 33701 (727) 896-8626, steve.brown@fwc.state.fl.us. Comparable data are also available on the Internet from the National Marine Fisheries Service at: http://www.st.nmfs.gov/st1/commercial/index.html

While fishery regulation is often designed for particular species, modeling the economic impacts of regulating the harvesting of individual species will be highly dependent on the particular technology involved. For example, with King Mackerel, the most economically important fin-fish harvested on Florida's east coast, hand lines and troll lines are the predominate gear types used. For the next most important fin-fish species, Swordfish, long-lines with hooks are used to catch the majority of value, and shrimp are caught primarily with bottom trawls. This is confirmed in Figures 8 and 9, where comparative landing values are shown for different gear classes and types for the five-year period between 1998 and 2002.

The percentage distribution of seafood harvesters and handlers across east-coast counties is reflected in Figure 10. The regional pattern is similar to that for the value of landings noted earlier, but with a larger concentration of dealers, brokers, processors and distributors in the southern most counties. The latter is likely explained by higher levels of import-export activities due to the location of port facilities in the area and the frequency of use by Latin American shippers.

Figure 1. Florida East Coast Fishery: Landings, Value and Implied Price, 1998 – 2002

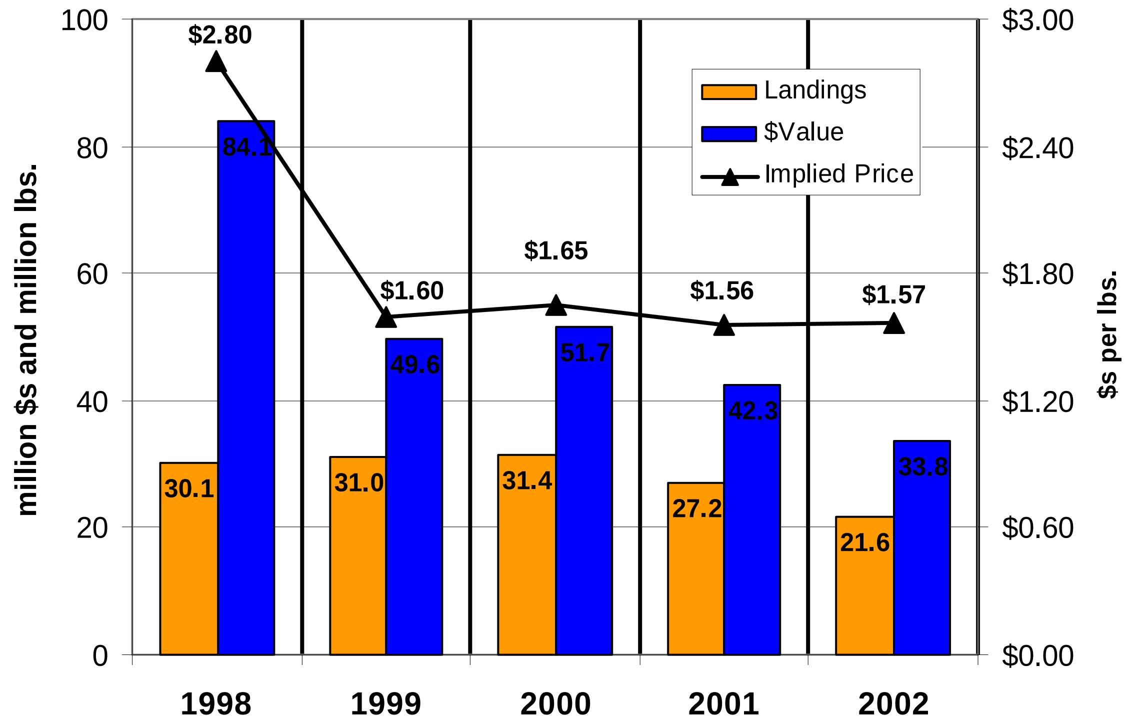


Figure 2. Florida East Coast Fishery: Sum of Landings and Value by County, for five years between 1998 – 2002

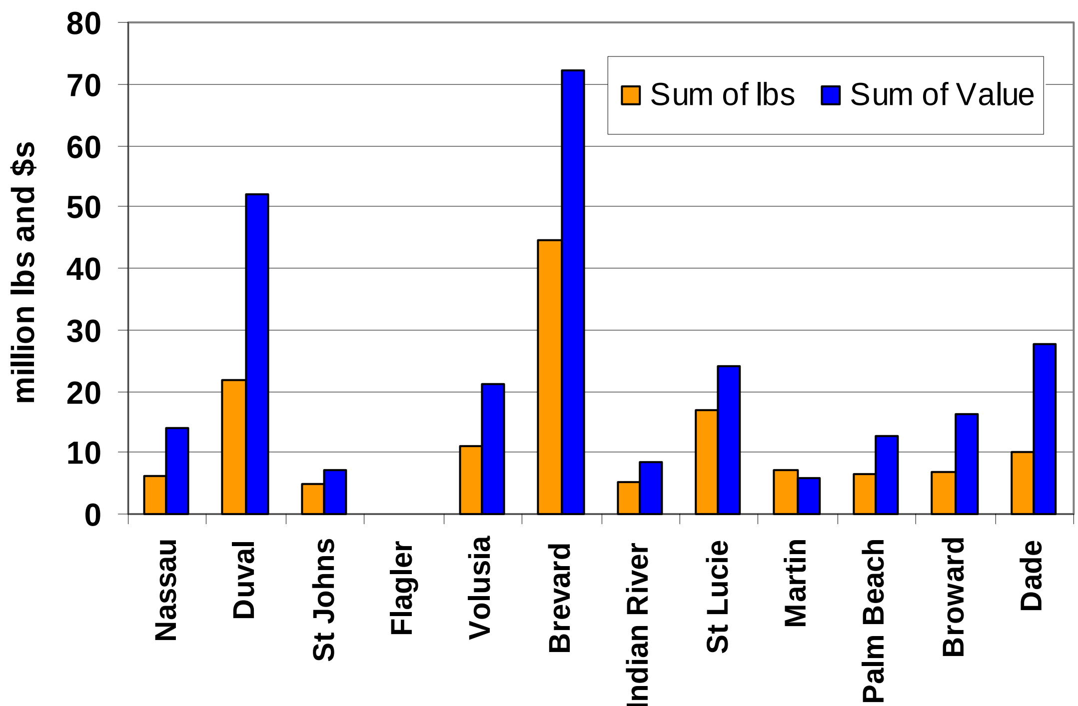


Figure 3. Bureau of Economic Analysis Economic Areas for the East Coast of Florida .

Figure 4. Florida East Coast Fishery: Sum of Value of Landings by County and Species Group for 5 years between 1998 – 2002.

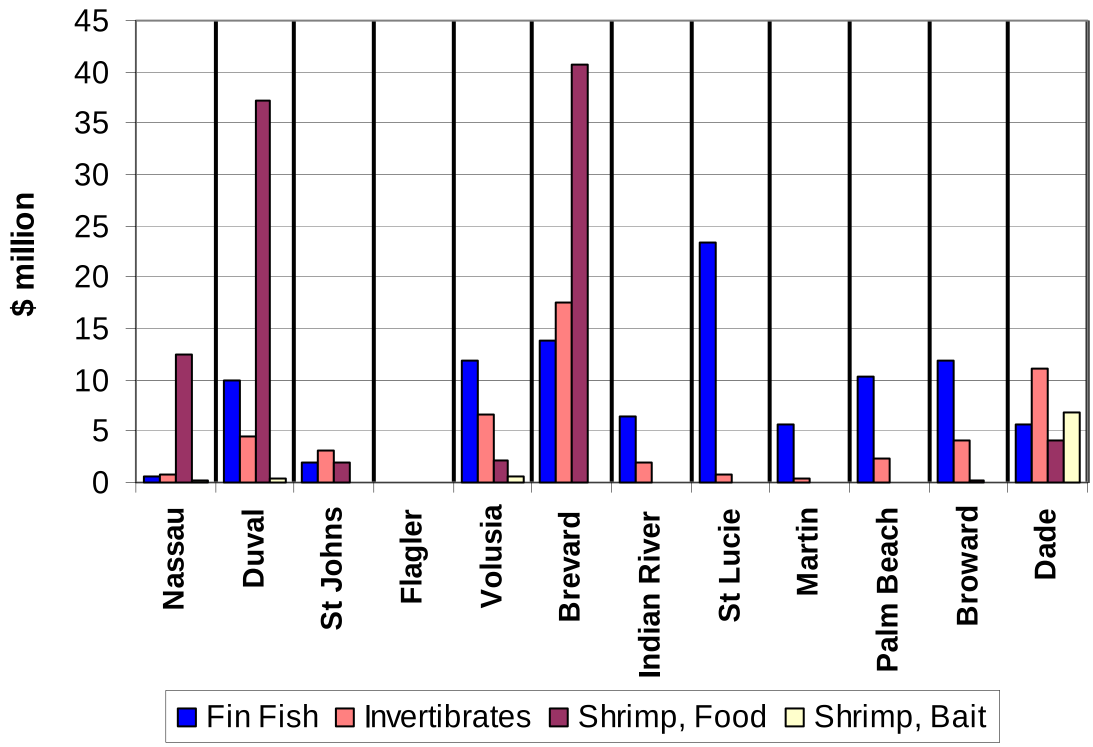


Figure 5. Florida East Coast Fishery: Sum of Value of Fin Fish Species with Total Landings Values Exceeding $1 Million for 1998 – 2002.

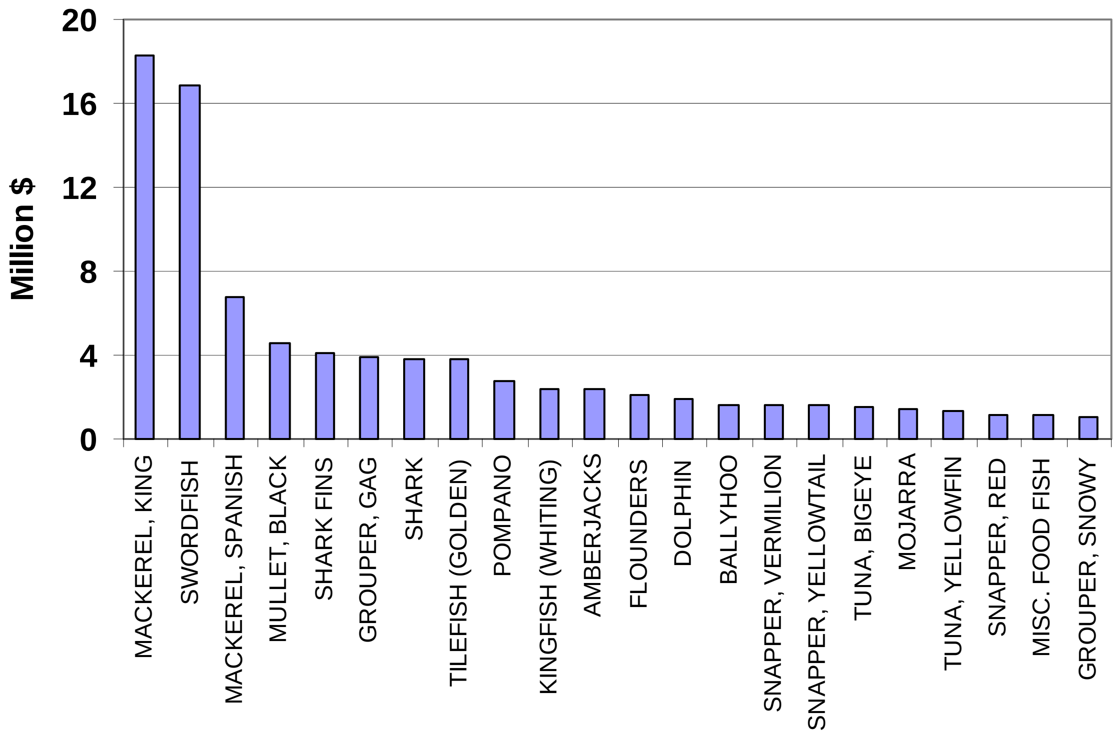


Figure 6. Florida East Coast Fishery: Sum of Value of Top Ten Invertebrate Species, 1998 – 2002

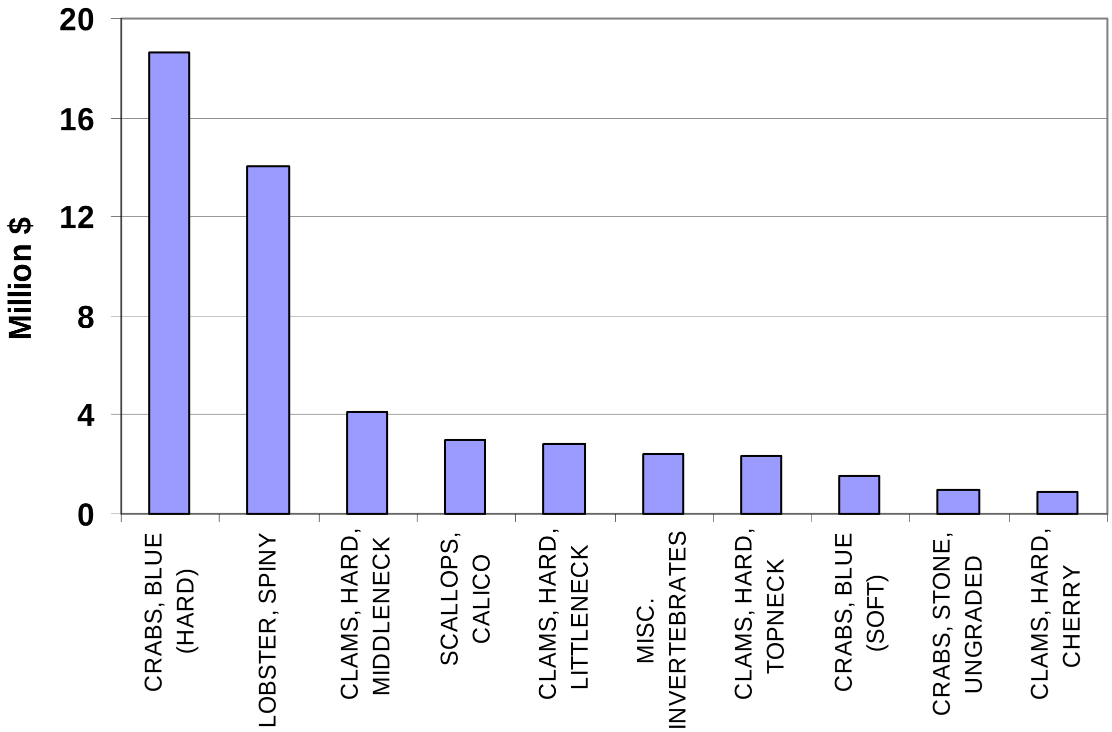


Figure 7. Florida East Coast Fishery: Sum of Landing Values of Shrimp, 1998 – 2002

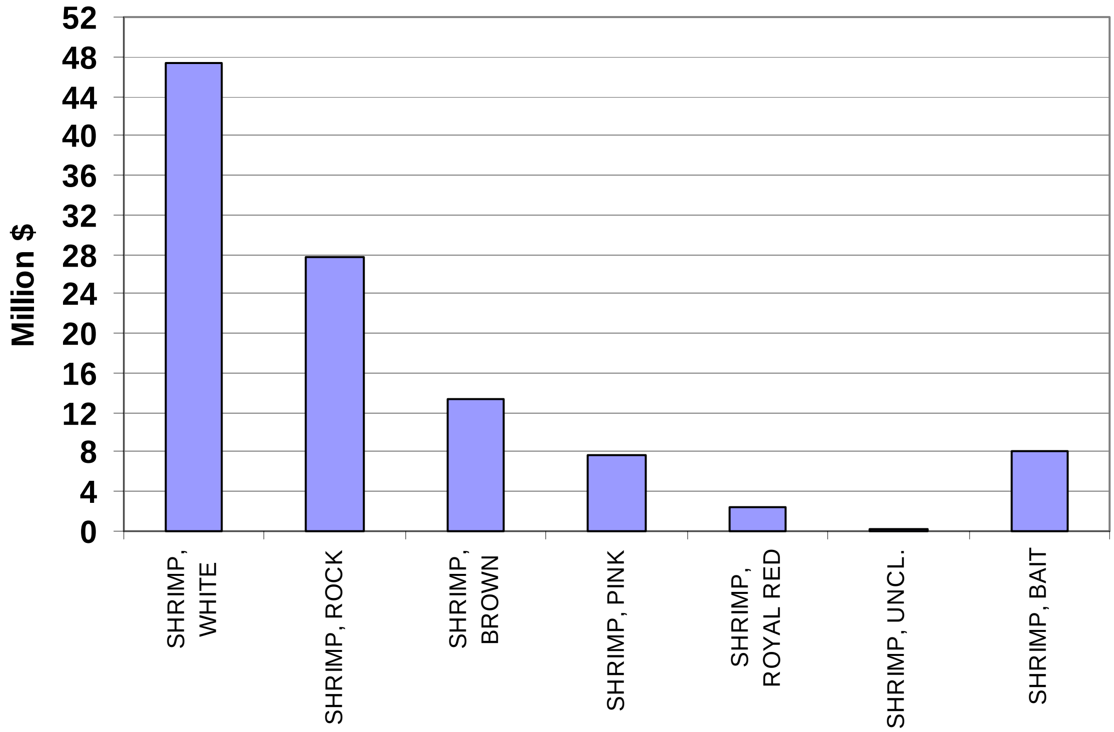


Figure 8. Florida East Coast Fishery: Sum of Landings and Values by Gear Class, for 5 years between 1998 – 2002.

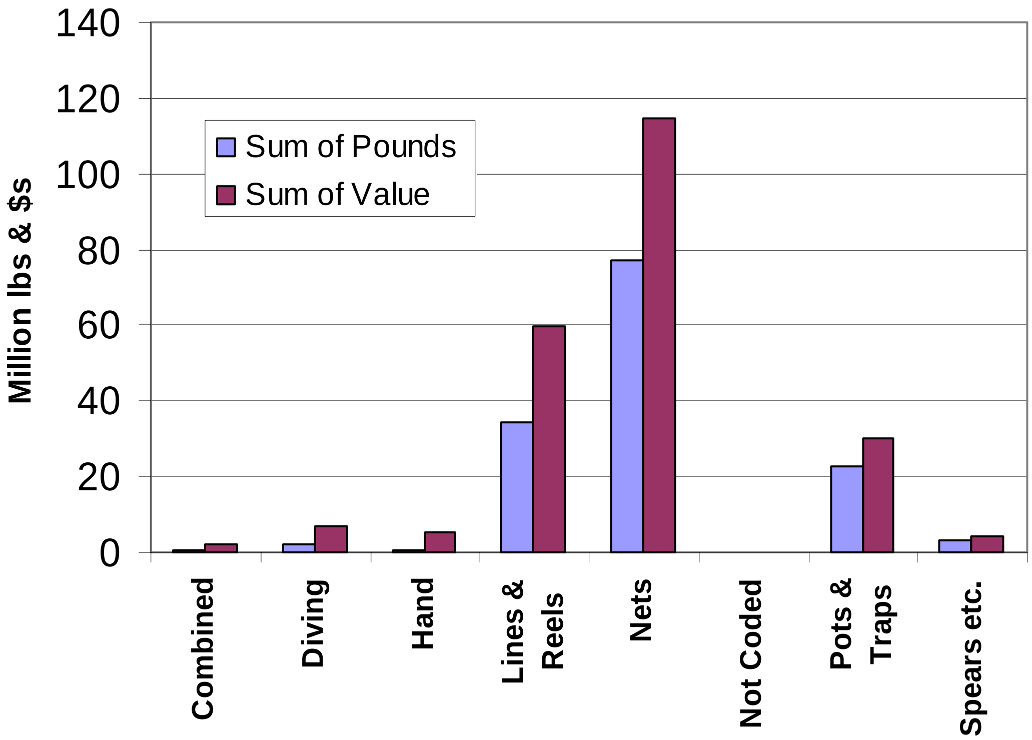


Figure 9. Florida East Coast Fishery: Cumulative Share of Total Value of Landings by Top Ten Gear-types for 5 years between 1998 – 2002

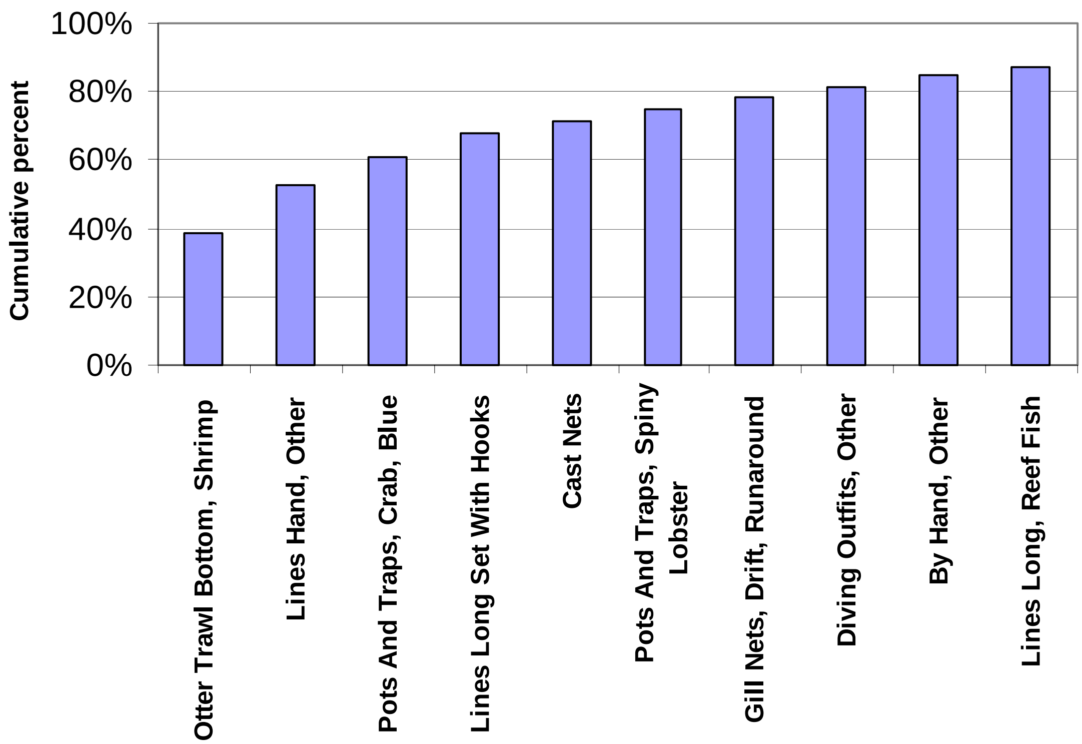
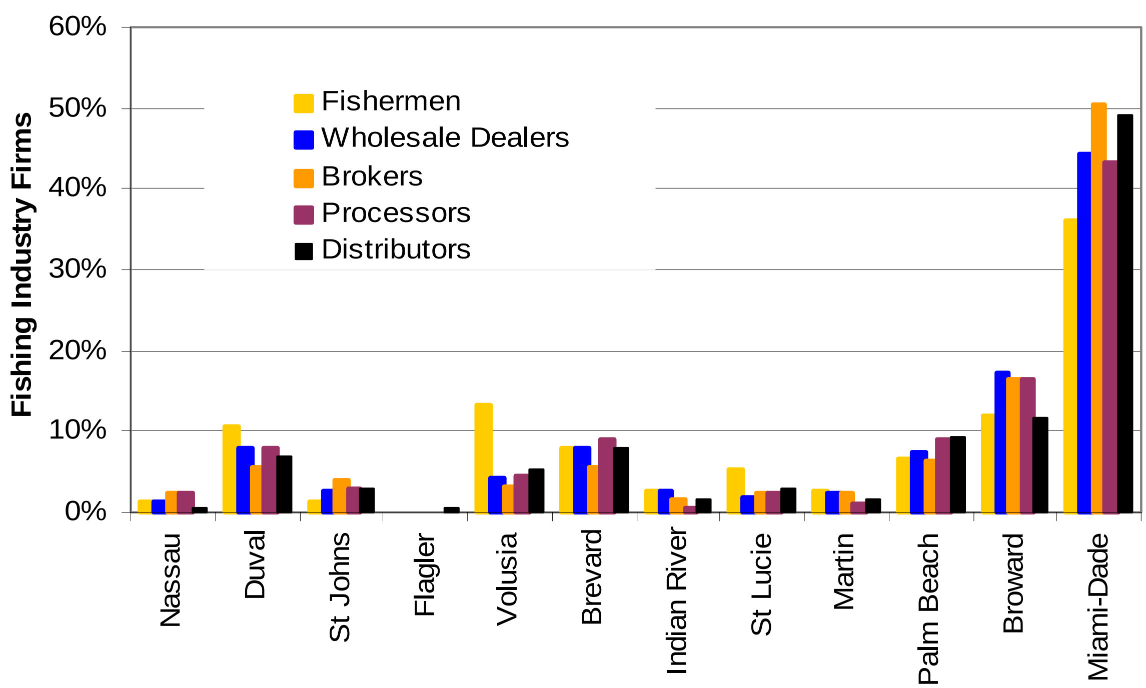


Figure 10. Percentage Distribution of Seafood Harvesters and Handlers along Florida's East Coast, 2003



Southeast Fisheries Science Center, www.sefsc.noaa.gov/seafooddealers.jsp

STATE AND FEDERAL FISHERIES DATA PROGRAMS

Considerable data collection programs have been developed to help monitor and evaluate and manage the fisheries around Florida and the Nation as a whole. Over time, cooperative relationships have been established between the National Marine Fisheries Services and the Florida Fish and Wildlife Commission (along with other states) so that fishery data collection and organization is more consistent and comprehensive. Table 1 summarizes the programs and types of data collection currently taking place for the east coast of Florida.

The Fisheries Logbook System requires fishermen to complete reports that are specific to several different types of fisheries, including: Pelagic longline, Gulf reef, South Atlantic Snapper-Grouper, Coastal Shark, and King and Spanish Mackerel fisheries (Figure 11). This program is implemented by the Southeast Fisheries Science Center (SEFSC). A Pelagic longline report is completed for each longline baited and set in the water (multiple longlines may be set during a single trip for this type of fishery). The logbook forms for the other fisheries summarize a single trip instead of individual sets. Data collected include: Vessel ID, date and length of trip, fishing location, gear type and quantity, and catch by species, weight and value. Cost and effort data fields have recently been added to this report and are discussed below.

To assess the age and size distribution of various marine fish species, the SEFSC also conducts a Trip Interview Program (Figure 12). Trip interviews are conducted on shore (at dockside or dealer locations) by trained surveyors. These surveyors also observe the composition of catch and take biological samples of fish caught. Biological samples are used to determine the age, reproductive status, and genetic characteristics of the catch. These first-hand interviews are also used to confirm logbook and trip ticket data (discussed below).

Commercial fishing vessels are counted and identified for regulatory purposes (in conjunction with the U.S. Coast Guard) through the NMFS's Vessel Operating Unit program (Table 1). This program only counts vessels that are registered with the US Coast Guard, which only includes vessels weighing 5 net tons or more.
NMFS has recently implemented a program to collect data on costs and returns of commercial fishing operations for the snapper/grouper & mackerel fisheries. Collected data include both fixed (annual) and variable (per trip) costs. Selected fishing vessel captains receive modified logbooks to record trip costs, in addition to annual (fixed) cost reporting forms (Figure 11 and Figure 13). This program is being conducted in collaboration with the Atlantic Coastal Cooperative Statistics Program to help insure the consistency and integrity of collected data.

A collaborative data collection program between individual states and NMFS to track fishery harvests is called the Accumulated Landings System. Marine Fishery Trip Tickets (Figure 14) are completed by seafood dealers and brokers. The species, weight, and value of fish purchased from fishermen are recorded in these reports on a per-trip basis. The length of time, area and depth fished, as well as gear-types used and type of fishing operation are also noted in these reports. These data are often reviewed by local NMFS port agents to reflect more accurate “ground truthed” data. Thus, the landings for an individual state as reported via local Trip Tickets may not match the adjusted Accumulated Landings System data.

The Atlantic States Marine Fishery Commission is currently developing a comprehensive data collection system, known as the Atlantic Coastal Cooperative Statistics Program. Part of this program will focus on market and vessel-level cost data. These data will allow for more effective state and federal management efforts.

As previously mentioned, the Florida Fish and Wildlife Commission (FWC) is responsible for conducting the Trip Ticket program (Figure 14). Although these data detail the landings for individual trips by fishermen, the State carefully maintains the confidentiality of these data by only releasing summaries of fishery landings by month, species, and location. These data allow the FWC and the NMFS to monitor fishery harvest and adjust regulations as needed to maintain healthy marine populations.

The SEFSC also maintains extensive lists of U.S. seafood dealers, brokers, processors, distributors and fishermen. These lists are made available to the public through their website at http://www.sefsc.noaa.gov/seafooddealers.jsp. All names and associated data are obtained from public sources or voluntarily provided to the agency. Data include business and contact names, address, phone number, email address, product types and species handled, also the types of processing carried out are listed.

Cost and Effort Data Requirements.

Data on the costs of production (harvesting), processing and distribution of goods or services are necessary to accurately conduct economic impact analyses. The cost of harvesting a specific marine species is determined to a substantial degree by the technology (types of vessels and fishing gear) used for this purpose. An analysis of the value of fishery landings by gear-type for the east-coast of Florida indicates that the following seven gear types are used in harvesting nearly 90 percent of the value of these landings: bottom otter trawl, hand lines, pots and traps, long lines, cast nets, drift or runaround gill nets, and diving (Figure 9). The cost and effort data that have been collected and published for 2002 do not include observations for trawls, or pots and traps. This is probably because the 2002 collection effort was focused on the snapper/grouper & mackerel fisheries and not crustaceans or shell fish.

To date, very little data has been discovered that specifically describe the technology and costs of processing and distributing seafood within the state of Florida. As with harvesting, this type of data could be used to improve the accuracy of estimated economic impacts from changing fishery regulations as they relate to the value-adding sectors of the seafood market channel. Also, if it is going to be important to estimate impacts of regulatory changes for particular sub-regions or communities within the State, then information on the flows of seafood related products and services between these areas within the State will be needed. As is the case for harvesting, the standard IMPLAN model has only one sector for seafood processing. There is no specifically designated IMPLAN sector to represent seafood dealing, importing, exporting, or distribution.

Table 1. Data and Information Sources Relevant to Fisheries Data and Socio-economic studies of the Fishery Industry.

Agency	Title of Data	Location/Contact/Completed by	Type of Data
National Marine Fisheries Service (NMFS), Fisheries Statistics & Economics Division, & Southeast Fisheries Science Center (SEFSC)	Fisheries Logbook System (FLS)	Written report forms completed by fishermen http://www.sefsc.noaa.gov/ http://www.sefsc.noaa.gov/fls.jsp	Catch & effort data by species, per trip or set. Includes species caught, by-catch, area of catch, type & quantity of gear, departure & return dates, landing & dealer location, fishing time & man hours.
	Trip Interview Program (TIP)	Collected at landing site or dealer location by port agents on South Atlantic & Gulf of Mexico coasts. http://www.sefsc.noaa.gov/tip.jsp	Size, weight & age data of catch by species determined through biological samples & personal interviews with fishermen. Catch & effort data collected include type & quantity of gear, crew size, & days fishing & trip length
	Vessel Operating Units (VOU)	Based on U.S. Coast Guard vessel data base http://www.sefsc.noaa.gov/vou.jsp	Characteristics and ownership data for commercial fishing vessels greater than five net tons
	Social & Economic Aspects of Fishery Management, Cost & Earnings Data Collection Program for South Atlantic Fisheries	Written report forms completed by fishermen (initially only snapper/grouper & mackerel fisheries) http://www.safmc.net http://www.safmc.net/socio/fmpro?-db=content&-format=default.html&-view	Voluntary random sampling for annual fixed costs & trip costs, including variable costs for a commercial fishing vessel's most recent trip, also sociological information through annual surveys of owner/captain/crew.
	Accumulated Landings System (ALS)	Reported by dealers/brokers to the Florida Fish & Wildlife Comm., usually on written Trip Ticket forms. See FMRI below http://www.st.nmfs.gov/st1/commercial/ http://199.242.233.242/sefsc/commercialprograms.jsp.htm	Quantity & value of domestic commercial seafood landings by species, gear-type, area, year/month as sold to dealers or brokers. NMFS coops with SE states to collect & process data. Maintained by SEFSC
	Seafood Dealer Lists	Lists of firms in seafood industry (National) http://www.sefsc.noaa.gov/seafooddealers.jsp	Business & contact name, address, phone, email, product types and species handled, types of processing carried out.
Florida Fish & Wildlife Commission, Marine Research Institute	Marine Fisheries Trip Ticket system	Reported by dealers or brokers to the Florida Wildlife Commission, & is then transmitted to the NMFS Accumulated Landings System. http://www.floridamarine.org http://www.floridamarine.org/features/view_article.asp?id=19224	Includes ID of harvester, purchasing dealer, date of the transaction, county landed, time fished, & pounds of each species landed. Used to generate Status & Trends Reports & support NMFS ALS.

Figure 11. Logbook Trip Report Form

2004 LOGBOOK TRIP REPORT FORM

Use **Black** Ink only !

OMB 00648-0016 Exp 12/31/2006
Version Date 08/03

Signature: ____________

Phone No. (   )   -

Schedule No. *NMFS Use Only*

Vessel No.: [| | | | | | |]

Start Date: [MM] [DD] [YY]

Unload Date: [MM] [DD] [YY]

County or Parish: ____________

Vessel Name: ____________

State : [|]

Dealer Number: ____________ *(if known)*

State Trip Ticket No.: ____________ *(if known)*

Days at Sea: [|]

No of Crew: [|]

Dealer Name: ____________

GEAR SECTION: **See Instructions on page 2.** Check gear box and fill in all the boxes below.

Date Received: NMFS use only

☐ Traps **(T)**		☐ Longline **(L)**		☐ Gill Net **(GN)**		☐ Rod & Reel / Handline **(H)**		☐ Electric Reel / Bandit **(E)**		☐ Trolling **(TR)**		☐ Divers **(S)**	**(P)**
# Traps Used		# Sets:		Length (yrds)		# Lines		# Lines		# Lines		# Divers	
# Hauls		# Hooks per Line		Depth (yrds)		# Hooks per Line		# Hooks per Line		# Hooks per Line		Hours	
Total Soak Time (hrs)		Length (Miles)		Mesh		Total Hrs Fished		Total Hrs Fished		Total Hrs Fished			
Mesh: x / x		Total Soak Time (hrs)		Total Soak Time (hrs)		☐ Other Gear : **(O)** ____________				**(o)** Hrs Fished			

CATCH SECTION: **See Instructions on page 3**

* **Weight** record pounds sold (Do not include fractions of pounds) GUTTED **OR** WHOLE
***Gear** Record code as T, L, GN, H, E, TR, S, P or O. ***Area** codes can be found on maps in logbook (Page 5)
***Price** record price per pound for fish sold

Group	Species Name	NMFS CODE	Gutted	Whole	Gear Code	Area	Price $.
JACKS	AJ - Greater	1812					
JACKS	AJ - Lesser	1815					
JACKS	Almaco	1810					
JACKS	Banded Rudderfish	1817					
JACKS	Crevalle	0870					
	Cobia	0570					
	Dolphin	1050					
Grouper	Black	1422					
Grouper	Gag	1423					
Grouper	Misty	1420					
Grouper	Red	1416					
Grouper	Scamp	1424					
Grouper	Snowy - Large	1414					
Grouper	Snowy - Med.	1414					
Grouper	Snowy - Small	1414					
Grouper	Yellowedge	1415					
Grouper	Yellowfin	1426					
Grouper	Red Hind	1413					
Grouper	Rock Hind	1412					
Grouper	Speckled Hind	1411					
GRUNTS	Bluestriped	1444					
GRUNTS	French	1445					
GRUNTS	White	1441					
GRUNTS	Margate	1442					
GRUNTS	Black Margate	1443					
GRUNTS	Grunts Unc.	1440					
	King Mackerel	1940					
	Spanish Mackerel	3840					
	Hogfish	1790					
	Wahoo	4710					
	Bluefish	0230					
	Blue runner	0270					
	Barracuda	0180					
	White Sea Trout	3455					
	Puffer / Blowfish	2760					
	Hake	1550					

Group	Species Name	NMFS CODE	Gutted	Whole	Gear Code	Area	Price $.
BASS	Black - Jumbo	3360					
BASS	Black - Large	3360					
BASS	Black - Med.	3360					
BASS	Black - Smal	3360					
Porgy	Jolthead	3312					
Porgy	Knobbed	3308					
Porgy	Red	3302					
Porgy	Whitebone	3306					
SHARK	Blacknose	3485					
SHARK	Blacktip	3495					
SHARK	Bonnethead	3483					
SHARK	Bull	3497					
SHARK	Dusky	3514					
SHARK	Finetooth	3481					
SHARK	Lemon	3517					
SHARK	Sandbar	3513					
SHARK	Sharpnose	3518					
SNAPPER	Blackfin	3757					
SNAPPER	Lane	3761					
SNAPPER	Mangrove	3762					
SNAPPER	Mutton	3763					
SNAPPER	Queen	3770					
SNAPPER	Red	3764					
SNAPPER	Silk / Yelloweye	3758					
SNAPPER	Vermilion > 2#	3765					
SNAPPER	Vermilion 1 - 2 #	3765					
SNAPPER	Yellowtail	3767					
	Gray Triggerfish	4561					
	Ocean Triggerfish	4562					
	QueenTriggerfish	4563					
	Blueline Tilefish	4474					
	Golden Tilefish Lg.	4470					
	Golden Tilefish Md.	4470					
	Golden Tilefish Sm.	4470					

TRIP EXPENSE & PAYMENT SECTION: **See Instructions on the bottom of page 3.** ***Record all the information below**

Fuel: Gallons Used This Trip	[| | |]	Price per Gallon	$ 0 . [|]	Trip Fuel Cost (Approximate)	$ [| | | |] . 0 0
Pounds Of Frozen or Dead **Bait**	[| | | |]	Number Of Live Bait	[| | | |]	Trip Bait Cost (Approximate)	$ [| | | |] . 0 0
Ice: Pounds Used	[| | | |]	Total Ice Cost (Approximate)	$ [| | | |] . 0 0	Food&Other supplies (Approximate)	$ [| | | |] . 0 0
Owner on Board : **Yes** [ ] **No** [ ]		Shares Paid To Captain & Crew	$ [| | | |] . 0 0	Do Payments Include Captain's Share?	**Yes** [ ] **No** [ ]

RETAIN THIS COPY FOR YOUR RECORDS

Figure 12. Trip Interview Program Form, Section 1 and 2

Data Collected Pursuant to OMB APPROVAL 0648-0013 - Expires 12/31/2001

REPORTING FORM FOR THE TRIP INTERVIEW PROGRAM (TIP)

Next Row is for Data Entry Personnel Use Only

PC Data Entry by:		Date:		Batch		Interview #:	

SECTION I

Interview Number											
Fishery Codes	CP	RF	OP		IN	ML	BF		EG	MX	SL
Trip Type	030	100	200	300	400	600	675	676	735	900	
Agent Code or Name			OR								
Date of Interview	Month		Day		Year						
Reporting Area of Landings	Reporting State				Reporting County				Reporting Area Zipcode		
Sampling Site	State		County		Zipcode		Sampling Location Code (Dealer or MRFSS)				
Start / End Date of Trip	Start Month		Start Day		Start Year		End Month		End Day		End Year
Information Source	SR Sales Records		LB Logs	CI	SS Site Sampling		SI Recs and Int		OD Observer Data		SO Recs and Observ
Fishing Mode	CM Commercial		CP Charter/Party		HB Head Boat		PR Private Rec		TR Torunament		SS Scientific Survey
Time of Data Collection -24hr	Begin	Hour :	Minutes		End	Hour :	Minutes				
Bias Type	NB No Bias		SB Size Bias		EB Effort Bias		SE Size & Effort		NI No Information		
Interview Type	FS Fisherman Sample			DS Dealer Sample			TS Trip Survey		AT Angler Trip		
Landings Type	CL Complete Landings (weight)			IL Incomplete Landings			NL No Landings		NF No Fish Caught		
Crew Size				(The number of crew including the captain)							
Total Effort	_ _ _ . _ Days Out		_ _ _ . _ Days Fished		Termination Code: UK	NR	WR	EQ	NF	SA	WI, OB, QR
Vessel Information	Vessel ID				Vessel Length (feet)				Vessel Name		

SECTION II

Gear Information				Effort / Location		
Code	Number	Quantity	Other	Soak Time (Hours)	Area Fished	Depth Range (Fathoms)
_ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _._ _	_ _ _ _ _._	_ _ _ _ _._	_ _ _._ / _ _ _._
_ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _._ _	_ _ _ _ _._	_ _ _ _ _._	_ _ _._ / _ _ _._
_ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _._ _	_ _ _ _ _._	_ _ _ _ _._	_ _ _._ / _ _ _._
_ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _._ _	_ _ _ _ _._	_ _ _ _ _._	_ _ _._ / _ _ _._
_ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _._ _	_ _ _ _ _._	_ _ _ _ _._	_ _ _._ / _ _ _._

Figure 12 (continued). Trip Interview Program Form, Section 3.

SECTION III										
Note	Spec Code	Size Code	Gear Code	Area Fished	Landing Weight	Weight Type	Value	Price	Number of Trips	Replicate Number
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+
___	____________	__	___	_____._	______	__	_____	___.__	___	__+

SECTION IV												
Rep #	Note	Species Code	Samp #	Samp Type	Catch Status	FISH IN SAMPLE			FISH IN SUB-SAMPLE			Form Rec 41
						Weight	Number	Type	Weight	Number	Type	
__	___	____________	__	__	_	_____.___	____	__	_____.___	____	__	_
__	___	____________	__	__	_	_____.___	____	__	_____.___	____	__	_
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Figure 13. South Atlantic Fisheries Management Council Annual Expenditures Survey Form

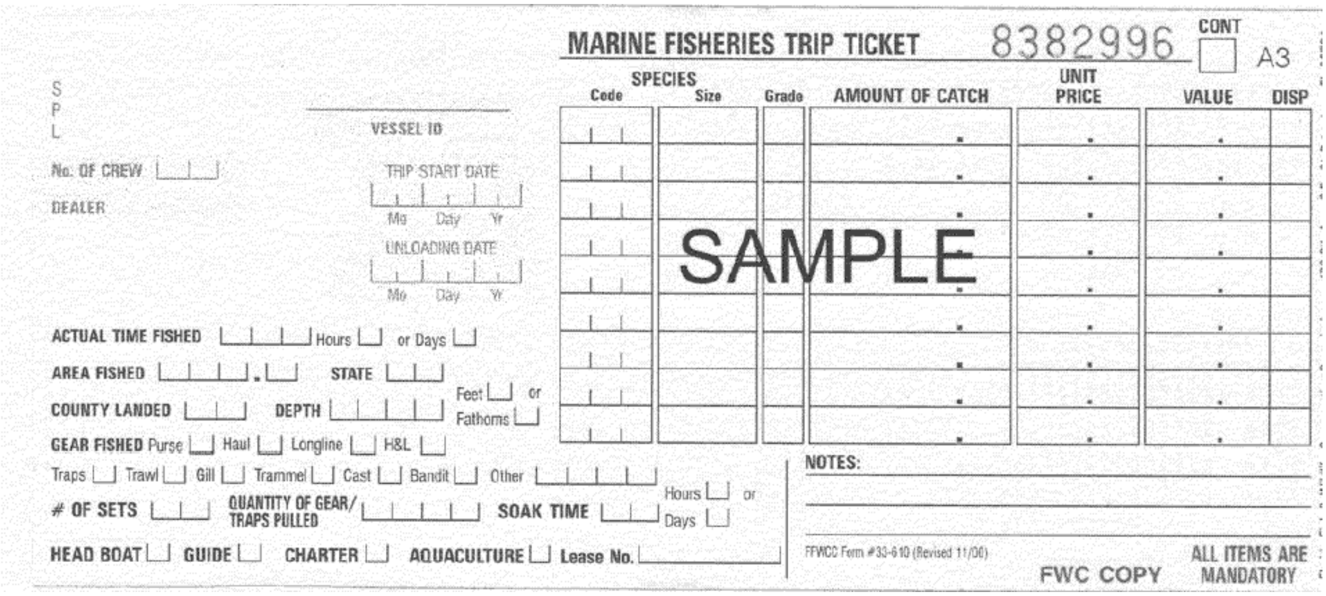
2002 ANNUAL EXPENDITURES

Boat Registration or Vessel Documentation Number: ☐☐☐☐☐☐☐☐☐☐

ANNUAL FISHING EXPENDITURES (Please report expenses to the nearest dollar)	
1. Types of fishing in 2002: Bottom Fishing ☐ Trolling ☐ Chartering ☐ Other ☐	
2. Tackle and Supply Expenses for all fishing (including hooks, line, clips, weights, and other supplies)	$ ______ . 0 0
3. Repair and Maintenance Expenses (include hull, engine, gear, electronics, safety equipment, etc.)	$ ______ . 0 0
4. Does this include haulouts? YES ☐ NO ☐	
5. Purchases of Gear & Capital (include gear, engine, electronics, safety equipment, anchors, etc.)	$ ______ . 0 0
6. Boat Dockage/Rent and Utility Expenses	$ ______ . 0 0
7. Insurance: Hull and P&I	$ ______ . 0 0
8. Does this include hull insurance? YES ☐ NO ☐	
9. Does this include P&I insurance? YES ☐ NO ☐	
10. Commercial Fishing Licenses & Permits	$ ______ . 0 0
11. Boat Loan & Business Loan Payments (or share of business loan payments associated with this vessel)	$ ______ . 0 0
SHARE OF OTHER BUSINESS EXPENSES PAID BY VESSEL	
12. Business taxes paid by vessel (include property and income taxes)	$ ______ . 0 0
13. Office Expenses (rent, accounting, legal, utilities, etc.)	$ ______ . 0 0
14. Car and Truck Expenses (Vehicle repair, maintenance, loan payments, lease expenses)	$ ______ . 0 0
15. Other annual or one-time-only expenditures paid by vessel (include business travel expenses, health insurance, relocation expenses, etc.)	$ ______ . 0 0
END OF YEAR ACTIVITY REPORT	
16. Number of days this vessel was used for commercial fishing and chartering:	☐☐ **DAYS**
17. Vessel's annual gross revenues from commercial and charter fishing	$ ______ . 0 0

Please return completed form to:
National Marine Fisheries Service
Logbook Program
P.O. Box 491500
Key Biscayne, FL 33149-9916

Figure 14. Florida Fish and Wildlife Commission Marine Fisheries Trip Ticket Form



MARINE FISHERIES TRIP TICKET 8382996 CONT A3

S P L

VESSEL ID

No. OF CREW

DEALER

TRIP START DATE Mo Day Yr

UNLOADING DATE Mo Day Yr

SPECIES Code	Size	Grade	AMOUNT OF CATCH	UNIT PRICE	VALUE	DISP

SAMPLE

ACTUAL TIME FISHED Hours or Days

AREA FISHED . STATE

COUNTY LANDED DEPTH Feet or Fathoms

GEAR FISHED Purse Haul Longline H&L

Traps Trawl Gill Trammel Cast Bandit Other

OF SETS QUANTITY OF GEAR/ TRAPS PULLED SOAK TIME Hours or Days

HEAD BOAT GUIDE CHARTER AQUACULTURE Lease No.

NOTES:

FFWCC Form #33-610 (Revised 11/00)

FWC COPY ALL ITEMS ARE MANDATORY

THE IMPLAN REGIONAL MODELING SYSTEM

Overview and Theory

Regional economic models constructed using IMPLAN are input-output (I/O) models and embody all the standard I/O assumptions such as constant returns to scale, no supply constraints, a fixed commodity input structure, homogenous sector outputs and the assumption that an industry uses the same technology to produce all outputs. Input-output models can then be used to assess the total effect on the economy resulting from direct changes in any one sector or combination of sectors. Models are demand driven and ideally suited to estimate the direct, indirect and induced effects of changes in the final demand for the product of any given sector. Expressed mathematically in matrix notation:

$$X - AX = Y$$

Where: X is a vector of outputs for each sector (1 though n) of the economy

Y is a vector of final demands for the product of each sector (1 though n) in the economy, and

A is a matrix of technical coefficients where each element a_{ij} reflects the purchase by a column sector j from each row sector i per dollar of sector j's output.

The equation is then solved for the output (employment and income) impacts, given a change in final demand:

$$X = (I - A)^{-1}Y ,$$

where X, A, and Y are defined as before, and I is an identity matrix. Each element of the inverse matrix a^{-1}_{ij} reflects the total output requirement from sector i per dollar of delivery to final demand by sector j. For a given sector j, summing across all i represents the multiplier effect of a final demand change in sector j. Effects captured include:

- Direct effects: sales, income and employment occurring directly in the sector in question, in this case the harvesting of fish, and the output of seafood dealers and processors.

- Indirect effects: sales, income and employment in those businesses linked to the sector in question through input purchases, in this case purchases include ice, fuel, bait, vessel repair, docking fees, insurance, etc. and

- Induced effects: sales, income and employment generated by the expenditure of incomes generated in the direct and indirectly impacted sectors of the economy.

Input-output models provide an estimate of impacts within one production period, usually one year, based on the effects of expenditure changes. They are not benefit-cost evaluations of particular activities nor do they provide a discounted sum of impacts over future production periods.[4] Impact estimates are based on the expenditures associated with a production activity within a single time period, usually one year.

IMPLAN Professional® (IMPLAN) is a commercially available software package and related databases available through MIG, Inc. (see earlier citation) that allows users to quickly develop regional input-output models for any county or group of contiguous counties or states within the United States. The software runs on IBM-compatible personal computers within Windows® 95, 98, NT, 2000 or XP operating systems. Model development using IMPLAN requires the purchase of the IMPLAN software ($450) and the regional data set ($1450 for all counties in Florida). MIG, Inc. also provides training at an additional cost. Updated data sets are available for purchase each year. There is an additional cost for a license to use the data set on more than one computer (the IMPLAN website has information on prices).

Industry Sectors and Regional Trade Flows

IMPLAN begins with national I/O matrices based on benchmark studies of the national economy conducted by the Bureau of Economic Analysis of the U. S. Department of Commerce. National I/O tables reflect the use of commodities to produce each industry's output (the use table), the production of commodities by industry sector (the make table), and details on value added and final demands by industry. A coefficient version of the use table (the absorption table) is a set of linear production functions for each industry sector of the national economy. Data are also available on output, employment and value added for each industry sector at the national level. For IMPLAN purposes, economic activities are grouped into 509 different industry sectors following the North American Industry Classification System (NAICS). The IMPLAN data set includes "bridge" tables to allow users to determine which activities are included in a given sector.

To allow the construction of regional models, the IMPLAN database contains statistics on output, employment, and value-added for each of 509 industry sectors in each county of the United States. Regional models may then be estimated for any region consisting of a county or group of contiguous counties within the nation. Although regional IMPLAN models are tailored to the particular distribution of industrial capacities of a given region, the production technology (the proportional use of commodity inputs to produce one unit of output) and the proportional distribution of industry outputs between intermediate industry sales and final demands embodied in these models are the same as those reflected in the national I/O tables. The assumption in the construction of regional models is that a given regional industry uses the same production technology to produce a unit of output as that industry does (on average) for the whole nation. Mathematically, this means that the production coefficients for the regional industry are the same as the national average for that industry. Regional coefficients may be smaller, however, depending on the mix of industries present in the region in comparison to the nation as a

[4] Information provided in the overview section is taken from the earlier cited IMPLAN User's Guide.

whole. Regional production coefficients reflect both the prevailing technology (from the national data) and whether or not industry inputs are purchased from within the region.

If a particular supplying industry does not exist within the region (employment is zero), then all coefficients reflecting input requirements supplied by that (missing) industry are set to zero, and regional models show those purchases as required imports. For other supplying industries within the region, some downward adjustment may be required based on available supplies relative to total intermediate and final demands for that output. IMPLAN procedures then estimate regional trade flows (imports and exports to and from the region) for each industry sector as part of the process of estimating regional production coefficients. This step is crucial since the size of resulting regional multipliers depends on the proportion of input requirements purchased within the region.

IMPLAN offers the regional analyst three options for estimating trade flows (regional purchase coefficients in IMPLAN terminology) within regional models. The “supply-demand pooling” approach maximizes local purchases and the magnitude of the resulting multiplier by requiring that, to the extent possible, local needs be satisfied by local production. All local demands for the output of a particular industry (either as intermediate products or final demands) must be satisfied before any of that industry’s output is exported from the region. Where an industry’s output is insufficient to satisfy local needs, all regional purchases from that industry are scaled downward proportionally and the balance is reflected as imports. This approach eliminates cross-hauling (regional imports and exports of the same good). In IMPLAN terminology, the regional purchase coefficient for a particular sector is set to 1.0 when regional production meets or exceeds regional requirements, and any excess production is shown as regional exports. When regional production is less than regional requirements, the regional purchase coefficient is less than 1.0 and represents the percentage of requirements supplied locally with remaining requirements supplied by regional imports.

A second option within IMPLAN for estimating trade flows is a “location-quotient” based approach. Here the extent to which a region specializes in a particular industry relative to the nation is assessed by calculating industry location quotients, the ratio of the percentage of regional employment in a given industry to the same percentage for the national economy. If the location quotient is greater than 1.0, the region is more specialized in production of that industry than is the nation as a whole, and the regional purchase coefficient is set equal to 1.0 (all needs are met with local production). For location quotients less than 1.0, regional purchase coefficients are set equal to the location quotient (less than 100 percent of local needs is supplied locally). In either case local purchases from a particular industry cannot exceed the output of that industry. Compared to the supply-demand pooling approach, the use of location quotients allows for some cross-hauling to occur and multipliers are generally lower.

The third option, and the one set as the default in IMPLAN when no choice is made, would use regional purchase coefficients estimated by a set of econometric equations within IMPLAN, with arguments in the estimating equations being some set of regional characteristics. As with the previous case, regional purchases from any given industry are constrained to equal regional output of that industry. That is, the regional purchase coefficient can never be larger than the one resulting from the supply-demand pooling option.

The final result of the estimating process contained within IMPLAN is a regional input-output model constructed by adjusting national production coefficients to reflect regional differences in production capacity (industry mix). While the underlying production technology remains the same as the national model, the adjustments in the coefficients reflect the degree to which inter-industry product flows are satisfied from within the region, or through imports or exports. These adjusted coefficients determine the magnitude of the estimated regional I/O multipliers. IMPLAN regional models calculate standard I/O Type I multipliers (direct and indirect effects), Type II multipliers (direct, indirect and induced effects), or Type SAM (social accounts matrix) multipliers that capture the effects of institutional transfers within the regional economy. Again, it is important to stress that regional models are based on all the standard I/O assumptions noted earlier, as well as the additional assumptions regarding the uniformity of technology between the region and the nation, and those assumptions associated with the choice of procedures for estimating regional trade flows.

Defining Study Regions

Previous sections provided a general discussion of estimating regional input-output models using IMPLAN without explicitly noting the critical step of defining the region for which impacts are to be estimated. As noted, IMPLAN allows regions to consist of geographic areas as small as counties and as large as multi-county or multi-state regions.

To some extent the definition of a region for a particular study depends on the nature of the impact question and the specific need for information. Such needs, however, must recognize that multipliers and resulting impact estimates are dependent on the size (economic and geographic) of the region. Ideally, the region suggested by the IMPLAN User's Guide and by regional theory should be one where most of the impacts associated with the purchasing activity of firms takes place within the region (a "functional" economic region) of interest. For example, in its treatment of the household sector (employment), IMPLAN assumes that employment is local. If in fact the region defined is too small and a large number of workers commute from outside the area, models will over estimate employment impacts. At the other extreme, if the region defined is too large, resulting estimates may not be meaningful for a particular location or political jurisdiction.

With respect to the particular application addressed in this report, the question of regional definition is equally important. A state model (Florida) would provide impacts specific only to the state of Florida with little meaning for any particular county (or community) in the state. On the other hand, individual models for each of the twelve counties along Florida's east coast would likely be unrealistic from the standpoint of the fishing industry and from the standpoint of providing models for functional regions. As noted in the earlier discussion of fishing activity along Florida's east coast, activity seems to fall within three regions (Figures 2), which corresponds to functional economic regions defined by the Bureau of Economic Analysis, U. S. Department of Commerce (Figure 3). It may also be possible to accomplish an acceptable level of sub-regional specificity in impact estimates by working with a state level model and then assigning a proportional allocation of indirect and induced impacts to the functional regions noted here.

Adjustments to IMPLAN

Once regional models are constructed, the IMPLAN software allows users considerable latitude in making adjustments where additional or more accurate data is available for particular regional industries. Users are able to view and edit the regional data set on which IMPLAN bases its calculations (industry output, employment and value added) and incorporate new data into the final model.

Likewise, IMPLAN users can view and edit regional household and institutional demands for commodities. There are nine household sectors within IMPLAN (based on income levels), federal defense and non-defense sectors, state/local government education and non-education sector, and an investment sector. Users may also adjust the amount of sales by a sector going to foreign exports, adjust the margins used for the wholesale and retail trade sectors, and margins for the transportation sectors as well, where those are appropriate to the sector of interest.

Finally, and perhaps most importantly for modeling impacts in the fisheries sector, IMPLAN allows users to edit regional production functions for particular industries where sufficient data is available to estimate new coefficients. Similarly, users have the flexibility of adding new sectors, or more precisely, disaggregating existing sectors to provide more precise specifications of regional industries. More detail on the reasoning will be offered later, but for the fisheries sector adjustments to the regional production function will likely be necessary due to wide variations in the nature of the industry by region. Due to these variations, regional production coefficients based on adjusted national averages will not closely reflect those of the fishing industry within any region.

With reference to adjusting IMPLAN, however, it is important to note that IMPLAN data sets contain much of the data that is readily available from secondary sources. IMPLAN allows the incorporation of additional data for specific sectors, but in many cases, the collection of primary data will be necessary to support major adjustments to standard IMPLAN models. For example, from the earlier discussion of fisheries along Florida's east coast, an adjusted IMPLAN model would require data on cost of production to allow the specification of the production function for each defined harvesting sector and information detailing the product flow between those sectors and defined dealer and/or processing sectors. Expanding the study to include sub-regions would require a similar data collection effort for each sub-region as well as information on the interaction among sectors across regions. All such efforts would likely require primary data collection efforts.

IMPLAN Fishery Sectors

The current version of IMPLAN captures fishing related activity in two economic sectors, one for fishing and an additional sector for processing activities. The two sectors are defined as follows:[5]

> **IMPLAN Sector 16 Fishing (NAICS 1141):** This industry comprises establishments primarily engaged in the commercial catching or taking of finfish, shellfish, or miscellaneous marine products from a natural habitat, such as the catching of bluefish, eels, salmon, tuna, clams, lobsters, mussels, oysters, shrimp, frogs, sea urchins, and turtles.[6]
>
> **IMPLAN Sector 71 Seafood Product Preparation and Packaging (NAICS 3117):** This industry comprises establishments primarily engaged in one or more of the following: (1) canning seafood (including soup); (2) smoking, salting, and drying seafood; (3) eviscerating fresh fish by removing heads, fins, scales, bones, and entrails; (4) shucking and packing fresh shellfish; (5) processing marine fats and oils; and (6) freezing seafood. Establishments known as "floating factory ships" that are engaged in the gathering and processing of seafood into canned seafood products are included in this industry.

There may however, be some seafood related activities that would not be captured in the two IMPLAN sectors described above. Note that industry classification is based on the primary activity of a given establishment. To the extent that businesses exist that primarily provide a purchase and resale function for raw seafood products in a given region, those activities could be classified as a part of the Wholesale Trade sector within IMPLAN. Again, this implies that adjusting IMPLAN models for a particular region will require information on the nature of the regional industry and the movement of products between harvesters, dealers, processors and final consumers.

REVIEW OF MODELING APPROACHES

IMPLAN has been widely used for impact analysis around the county with issues involving commercial fisheries. The section provides a brief review of those efforts as a basis for establishing alternative approaches to the question as it relates to Florida's east coast and commercial fisheries. Particular attention will be devoted to work by Steinback and Thunberg[7] in developing a multi-regional impact model for commercial fishing in

[5] Executive Office of the President, Office of Management and Budget, North American Industry Classification System, United States, 1997.

[6] Farm raising of finfish, shellfish, or other marine animals is classified separately by NAICS and is included in an animal production sector by IMPLAN.

[7] Steinback, Scott and Eric Thunberg, "An Approach for Using IMPLAN and its Associated Data Package to Estimate the Economic Activity ("impact") Resulting From Fishery Management Actions. Northeast Fisheries Science Center. NMFS National Social Scientists Workshop, La Jolla, California, February 22-25, 2000.

New England and supporting work completed at Woods Hole Oceanographic Institution,[8] work by James Kirkley[9] in developing spreadsheet models using basic IMPLAN multipliers to capture indirect and induced impacts, and a U.S. west coast modeling application (F.E.A.M.)[10].

This literature review is not intended to be exhaustive of fishery impact studies using IMPLAN. Rather, the intent is to establish the nature of the modeling problem (a conceptual approach) and identify the major approaches to addressing impact estimation within that conceptual framework. The actual modeling applications mentioned for review in the previous paragraph are examples of different approaches. The FEAM model is not treated in detail since its basic logic is similar to that of the Mid-Atlantic model developed by Kirkley.

Modeling Fishery Industries: A Conceptual Framework

The process or challenge of adapting IMPLAN type input-output models to fisheries applications can best be understood within a conceptual framework that outlines the modeling issues in a manner consistent with input-output logic. The framework can then be used to assess different approaches to modeling impacts for commercial fisheries.

<u>Input-Output Logic and Product Flows</u>

Input-output models divide the economy into economic sectors (groupings of like businesses) and track the movement of goods and services (linkages) between businesses and between businesses and final consumers. Thus, the first step in applying input-output models to fisheries is to delineate the product flows of interest in a manner consistent with the standard input-output framework. Figure 15 provides an overview of product flows in the context of input-output logic adapted from the earlier cited work by Steinback and Thunberg.

In Figure 15 commercial harvesters of fish and marine products generate sales, employment and income through the harvesting and marketing of fish. Harvesters, in turn, make purchases of the inputs required to conduct harvesting operations (fuel, boat repair, nets, ice, insurance, food, etc.). Commercial harvesters sell seafood products to seafood dealers or to seafood processors (direct sales to consumers are not shown here to simplify the diagram), and seafood dealers may resell products to processors. Seafood processors generate sales, income and employment by selling processed products to consumers through other intermediate sectors (grocery stores and restaurants) to exports

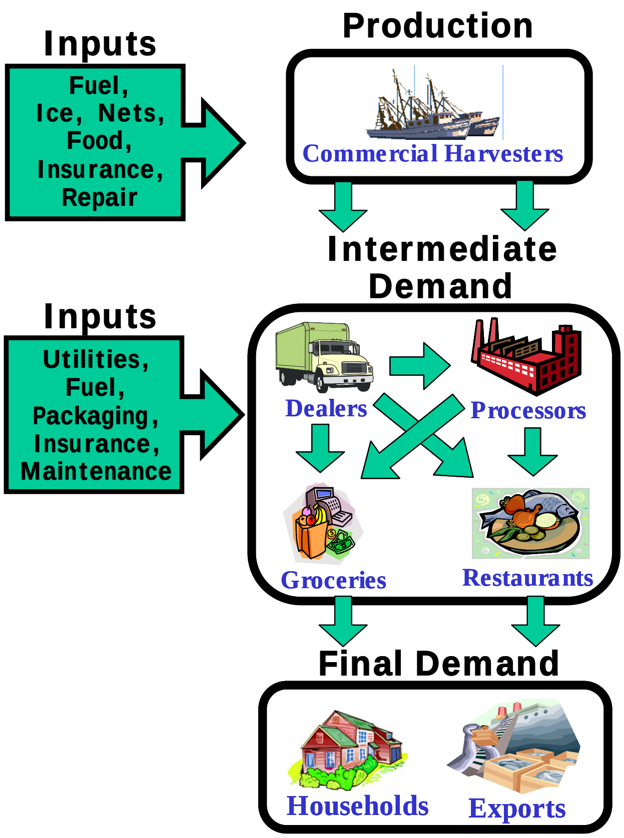
[8] Woods Hole Oceanographic Institute, Marine Policy Center, "Development of an Input-Output Model for Social Economic Impact Assessment of Fisheries Regulation in New England." MARFIN Project Final Report to National Marine Fisheries Service Grant Number NA87FF0548, March 2000.

[9] Kirkley, James E., "Assessing the Economic Importance of Commercial Fisheries in the Mid-Atlantic Region: A User's Guide to the Mid-Atlantic Input/Output Model." School of Marine Science, College of William and Mary. Report prepared for the Northeast Science Center, NOAA Fisheries, National Marine Fisheries Service, Woods Hole, Ma.

[10] Jensen, William S., "Notes on Using the FEAM Economic Impact Model: A Practitioner's Approach," Prepared for Steve Frese, Economist, National Marine Fisheries Service, May 1998.

or directly to final consumers. Seafood dealers generate sales in the same manner by selling to grocery stores or restaurants, directly to final consumers or exports, or to seafood processors. Harvesters, dealers and processors may also be vertically integrated through common ownership or long-term contractual arrangements. Regardless, dealers or processors (or those functions) will make additional purchases to support their operation (utilities, insurance, packaging materials, etc.).

Figure 15. Input-Output Logic and Fishery Product Flows



An input-output model reflecting the fishery industry depicted in Figure 15 would have three sectors (commercial harvesting, seafood dealers, and seafood processors) directly involved in the production and processing of seafood. Additional sectors involved in the movement of seafood from producers to consumers would include wholesale and retail trade, restaurants, and transportation (not shown in figure) sectors. The model would have information on sales, income, employment, and value added and input purchases for each producing sector and would show the allocation of sales between intermediate demand (sales to other producing sectors) and final demand (consumers and exports). The transportation and trade sectors would reflect the appropriate margins associated with product movement.

Once structured, an input-output model such as the one described here fully captures the interactions of the seafood producing and handling sectors with all other sectors of the economy. Model information would reflect purchases by the seafood industry from all other sectors of the economy and sales to all other sectors and to final demand.

Application to Regulatory Changes in Fisheries

As noted above, the input-output model described in the previous section in terms of product flows depicted in Figure 15 is a demand driven model ideally suited to assessing the economic impacts of changes final demand (changes in consumers sales or exports). Resulting multipliers would trace the effects of such a change backward through the various industry linkages from grocery stores or restaurants to processors, seafood dealers, commercial harvesters and all other sectors directly or indirectly related through input purchases. The model would also capture the induced (spending) effects of changes in income in the various sectors.

The scenario of a final demand change is not, however, the most likely when considering impacts resulting from changes in fishery regulations. Such changes are more likely to impact the output of the commercial fishing sector, and the analyst must decide how such a change will affect the output of seafood dealers and processors, and final consumption. Outputs of the forward-linked sectors may be reduced in proportion to the decline in the availability of fish products from the commercial harvesting sector, or, dealers and processors may continue to operate at the same level by substituting other species or other products, or they may increase the use of imported products. Consumers will not likely reduce total consumption, but are more likely to make product substitutes either by consuming other types of seafood or substituting non-seafood products.

The analyst must decide, in dealing with this issue, on the extent to which impacts reflected in the forward linkages are to be captured by any impact analysis. To the extent that such impacts are to be considered, analysts must have information on how the forward-linked sectors respond to changes in product availability. The simplest assumption is that the output of each forward-linked sector will decline in a manner proportional to the change in the output of the commercial fishing sector with adjustments for the yield of processed product from a given volume of raw seafood. Obviously, product substitution becomes more likely as one moves further up the production chain away from the harvesting sector. Within the input-output framework, however, which captures the relationships between all sectors, care must be taken to avoid double-counting when considering both harvesting sectors (commercial fishing) and forward-linked sectors (seafood processing).

Approaches to IMPLAN Applications

In general, there are two ways in which an analyst might approach the use of IMPLAN to estimate economic impacts of changes in the output of the commercial fishing sectors (or related dealer and processing sectors). In one approach, IMPLAN multipliers are generated for all sectors of a regional economy using standard IMPLAN procedures for compiling regional models. Resulting multipliers for non-fishing sectors are then used in calculations external to IMPLAN to estimate impacts associated with independent estimates of expenditures by fishing related sectors (similar to the effort by Kirkley). A second approach focuses on using the “Impact Module” provided within the IMPLAN software to calculate impacts of potential changes in fishery output. This approach requires the creation of new fishery and fishery-related sectors within IMPLAN or adjustment of existing fishery sectors. The latter approach is embodied in the work of Steinback and Thunberg.

With either of the general approaches an analyst may proceed in a systematic or an ad hoc fashion. The latter is intended to describe attempts to estimate the impacts of specific changes in specific locations without regard to the impact of the overall fishery on the regional economy. The systematic approach is descriptive of attempts to build more comprehensive models at the regional level that capture the impacts (interactions) of the entire fishery related industry. Both the effort by Kirkley and that by Steinback and Thunberg as well as the FEAM model represent systematic efforts to capture the total economic impact of the entire fishing industry within the region(s) of interest. Each general approach is described below after comments related to the estimation of direct impacts.

Estimating Direct Impacts

A key point before addressing IMPLAN applications is to reinforce the point made earlier regarding the direct impacts of changes in the fishery sector. IMPLAN applications in either of the cases mentioned above will require estimates of direct output changes in fishery related sectors. Such changes are made independently of information contained within IMPLAN.

The extent of the direct impact estimates required will depend on the level of analysis selected for the total impact estimates. If the focus is only on the commercial harvesting sector and potential changes generated indirectly with the production of seafood products at that level, then only estimates of direct changes in the value of landings will be required. If the analysis is to focus on the forward-linked sectors, then direct output changes must also be provided for those sectors prior to developing any IMPLAN applications. Further, the fishery model outlined in terms of Figure 15 contains only three fishery related sectors (harvesting, seafood dealers, and processors) and is described in terms of one region. To the extent that additional harvesting, dealer, or processing sectors are specified, or if the analysis is extended to include more than one region, the task of estimating direct changes in outputs, and the data required to do so, expands accordingly.

Kirkley Mid-Atlantic Approach

This approach implicitly begins with the assumption that the fishery sectors (harvesting and processing) within a standard IMPLAN model are not adequate for completing fishery impact estimates for any specific component of the fishery industry in any specific region. As noted earlier, such an assumption is likely valid in that any particular component of the fishery industry will depart rather substantially from standard input-output assumptions of homogenous sector outputs and similar production technologies. This approach allows the analysis to proceed without requiring adjustments to information contained within IMPLAN, and impact calculations can be performed using spreadsheets.

The procedure begins by using a regional IMPLAN model to calculate multipliers for those sectors of the regional economy impacted by expenditures of the fisheries sector. The IMPLAN multipliers are then applied to the estimated fishery sector expenditures to derive the impacts. The basic idea is that an expenditure by a fishery related sector represents a direct impact on some other sector of the regional economy and that sector's activity then has an indirect and induced impact captured by its multiplier. A simple example can be illustrated with some examples of typical expenditures and sector allocations taken from Kirkley.

Typical expenditures by a commercial fishing sector would include purchases of goods (gear, hardware, supplies, electronics), repair expenses (gear, nets, boats, engines), trip expenses (groceries, fuel, ice, bait), fixed expenses (moorage, licenses, insurance, accounting, etc.) as well as labor expenses (crew and captains share) and the owner's profit. Again following Kirkley, expenditures would be allocated to appropriate IMPLAN sectors (Table 2). The multiplier for each IMPLAN sector would then be used with the expenditure by fishery industries in that sector to estimate the impact. For example, expenditures by commercial harvesters for vessel maintenance would be allocated to the Boat Building and Repair sector within IMPLAN. Multiplying the dollar expenditure by the Boat Building and Repair multiplier would capture the indirect and induced effects of spending on vessel maintenance within the regional economy. The total impact would equal the summation of all sectors impacted by fishery expenditures. To fully capture impacts, the share of expenditures representing labor income and profits must also be converted to expenditures and allocated to the appropriate IMPLAN sectors.

Table 2: Typical Fishing Expenditures and IMPLAN Sectors

Expenditures	**IMPLAN Sectors**
Bait	Commercial Fishing
Ice	Manufactured Ice
Maintenance and Repair	Boat Building and Repair
Insurance	Insurance
Rent	Real Estate
Margin allocations	Wholesale & Retail Trade
Margin allocations	Transportation & Food Stores

This approach requires knowledge of the expenditures associated with harvesting seafood products (independent of IMPLAN), and the allocation of those expenditures to the appropriate IMPLAN sectors. Further, allocated expenditures must be reduced by the proportion of input purchases that take place outside the region to avoid over estimation of impacts. In every case, whether expenditures represent crew income and profit or vessel operating costs, when purchases involve margin sectors within an input-output framework (trade and transportation), efforts must be made to allocate the margins to the appropriate sector.

While the discussion above is in terms of a commercial harvesting sector, attempts to include estimates associated with seafood dealers or processors would require similar information and actions for those sectors. The projected change in output of the commercial production sector would first have to be translated to an output change at the dealer level based on the yield of wholesale or processed product from a given volume of raw seafood product. Information on expenditures for other production inputs by dealers or processors would also be needed. Again, care must be taken at this step to avoid double counting impacts. Double counting can be avoided by estimating dealer or processor impacts net of the value of the seafood product at the harvester level.

Steinback-Thunberg New England Approach

The Kirkley Mid-Atlantic approach discussed in the previous paragraphs generally requires little expertise at using or adjusting IMPLAN models. Multipliers are extracted from a standard regional input-output model generated in IMPLAN and then exported to spreadsheet software to complete the impact analysis. The Steinback-Thunberg approach directly modifies the number of sectors, production functions, trade flows, and distribution of outputs within IMPLAN to estimate a regional model that reflects the characteristics of those sectors in the regions that harvest, process and distribute seafood products.

This approach requires much more familiarity with the modification and use of the IMPLAN software during model development. Data similar to that on expenditures used in the Kirkley approach will be necessary to estimate new production functions for fishery related sectors in a Steinback-Thunberg type IMPLAN model. By the same token, in the process of specifying the new IMPLAN production function, expenditure data must be allocated to the appropriate IMPLAN sectors, and adjustments will be necessary when direct expenditures by the fishing related sectors take place outside the region of interest. Information will also be required on the movement of product between fishery related sectors (i.e.; harvesters, seafood dealers, and processors), between each of these sectors and the various components of final demand (consumers and domestic and foreign exports), and on the handling of final products by various margin sectors (trade and transportation) between producers and consumers.

Once the regional models are constructed, this approach will have the same problem as noted before; the model is demand driven while the problem is more one of assessing the impact of changes in supply at the harvester level. The same decisions must be made about whether or how many of the forward-linked sectors to include in the impacts, and the same level of care is required to avoid double counting impacts. Impacts can, however, be calculated using the standard impact module within the IMPLAN software which takes full advantage of the complete interaction between sectors within the model and allows a more detailed assessment of impacts across sectors. Income, for example, would accrue to the household sector and be expended in accordance with model coefficients without requiring the separate step of calculating household expenditures. Other fishing expenditures by seafood sectors will be distributed by IMPLAN based on the estimated production functions for each sector. The percentage of those products supplied locally, however, will be determined by the IMPLAN regional purchase coefficient for the supplying sectors and will require verification to make sure that the adjusted model allocates the correct proportion of expenditures to regional sectors as opposed to regional imports.

Sectors, Regions and Applications

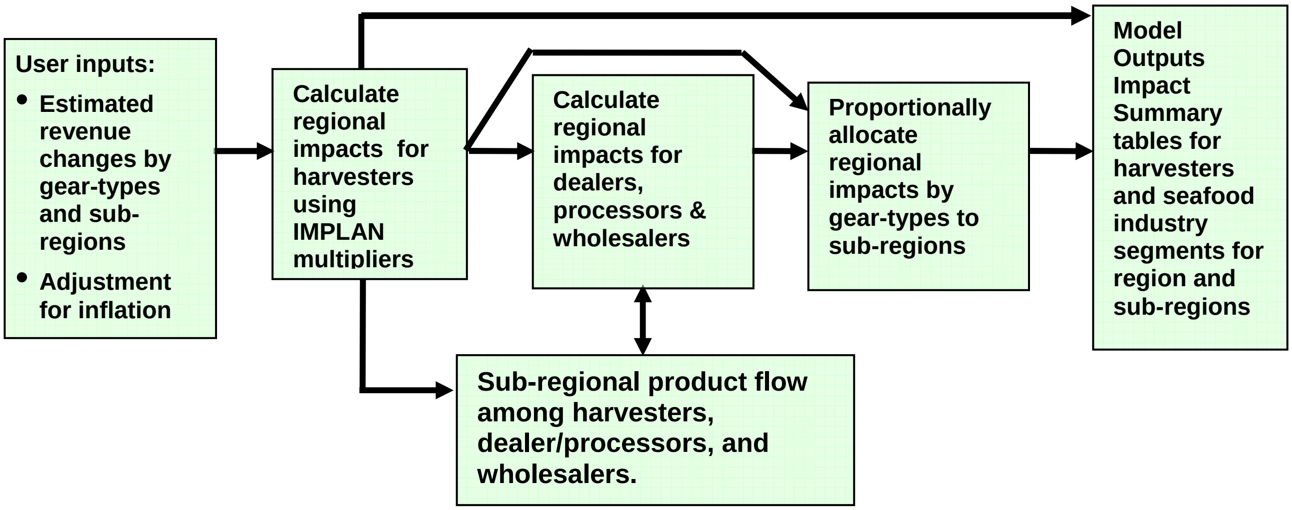
The issue of the number of sectors and specific regions is best addressed with reference to and further explanation of the two specific models referenced earlier, the works by Kirkley and that by Steinback and Thunberg. Both represent systematic attempts to capture the impacts of the entire fishery at the regional level, both disaggregate commercial fishing into a number of harvesting sectors, and both consider sub-regional impacts within the broader Mid-Atlantic and New England regions. The general logic of each model will be presented first. This will be followed by a more detailed discussion of the delineation of sub-regions and sectors.

Figure 16 depicts a general outline of the approach employed by Kirkley. The model is multi-sector and multi-region, and the user is required to specify the value of landings for each sector in each region. Spreadsheets then calculate the total impacts using multipliers for regional sectors estimated using standard IMPLAN input-output models. In terms of forward linkages, the model also calculates within the spreadsheets the impacts associated with activities for seafood dealers, processors and wholesalers with accounting for product flow among harvesters, processors, and dealers across sub-regions. The final step in the model is to allocate total impacts to sub-regions of interest. Total impacts of fishing related activity are first calculated for the multi-state, Mid-Atlantic region and then allocated to sub-regions based on the existing income, employment or output for each sector relative to that of the larger region. The Kirkley model does not include the impacts associated with the final distribution of seafood products. The model does take the steps necessary to avoid double counting when dealer and processor sectors are included.

The New England model developed by Steinback and Thunberg is in many ways similar to the effort by Kirkley for the Mid-Atlantic region. For fishing related industries the model is multi-sector and considers several sub-regions within a five-state New England region, and like the Kirkley model it captures the impacts of harvesting , seafood dealers and processing. Impacts are calculated for the entire New England region and then allocated to sub-regions using either employment, income or output in the sub-region relative to the larger region (Figure 17).

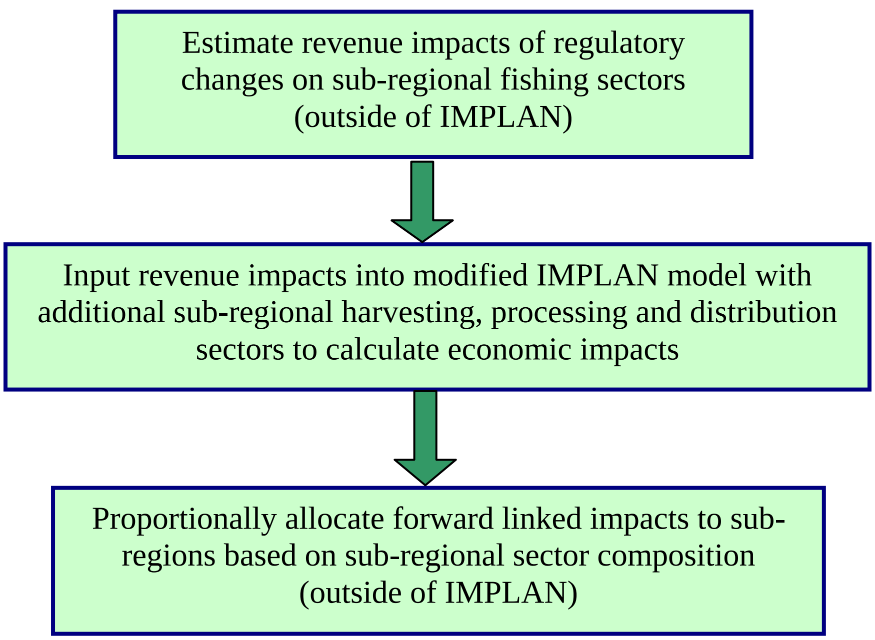
The key difference is that the Steinback-Thunberg model adjusts all fishing related sectors within the New England input-output model estimated using IMPLAN. In this manner all impact calculations take place using the standard IMPLAN impact module rather than separate from IMPLAN as in the Kirkley approach. Sub-regional impacts are then allocated proportionally as in the Kirkley approach.

Figure 16: Schematic of Mid-Atlantic (Kirkley) Impact Model



Adapted from James E. Kirkley,
"Assessing the Economic Importance of
Commercial Fisheries in the Mid-Atlantic
Region: A Users Guide"

Figure 17. Schematic of New England Fisheries (Steinback-Thunberg) Impact Model.



Defining Fishing Related Sectors and Sub-regions

Both the Mid-Atlantic and the New England fishery models are multi-sector in nature and related in the sense that the New England model served as a guide for defining sectors in the Mid-Atlantic model (Table 3). Sectors are defined based on the types of fishing gear employed with the idea that it is the choice of technology that determines the expenditures and the ultimate impacts of fishing on the regional economy. Both models address impacts across several sub-regions of the broader Mid-Atlantic (seven state) or New England (five state) region. The Mid-Atlantic region model addresses 12 distinct sub-regions while the New England model sub-divides the region into 11 coastal sub-regions and one non-coastal sub-region containing the rest of New England. The models then estimate impacts for the broader region and allocate those impacts to the sub-regions contained within the model.

Table 3. Fishing Related Sectors: Mid-Atlantic and New England Models

Mid-Atlantic Model	New England Model
Inshore Lobster	Inshore Lobster
Offshore Lobster	Offshore Lobster
Large Bottom Trawl	Large Bottom Trawl
Medium Bottom Trawl	Medium Bottom Trawl
Small Bottom Trawl	Small Bottom Trawl
Large Scallop Dredge	Large Scallop Dredge
Medium Scallop Dredge	Medium Scallop Dredge
Small Scallop Dredge	Small Scallop Dredge
Surf Clam/Ocean Quahog	Surf Clam/Ocean Quahog
Midwater Trawl	Sink Gillnet
Bottom Longline	Diving Gear
Other Gear	Midwater Trawl
Pots and Traps	Pots & Traps (other than lobster)
Gill Nets	Bottom Longline
	Other Mobile Gear
	Other Fixed Gear
	Hand Gears (rakes, hoes, etc.)

The key difference between the models, as noted before, is that Steinback and Thunberg first estimate a regional model (for New England) and then expand that model by including specific sectors for each gear type noted above in each sub-region. A seafood dealer and two processing sectors is also defined for each sub-region for a total of 20 sectors for each sub-region. The expanded New England model (using the current NAICS aggregation for IMPLAN) would begin with the original 509 IMPLAN sectors. The fishing-related sectors would then be disaggregated to include the new sectors. In terms of total sectors, this effort would add 20 sectors times 11 sub-regions or 220 new sub-regional sectors. Other sectors determined to be fishery related were also disaggregated. The final version of the New England model resulted in an IMPLAN model with more than 900 producing sectors. These additions require not only disaggregation of the sectors at the sub-regional level, but they also require adjustments to the national data tables within IMPLAN (in Microsoft access) to allow the IMPLAN software to recognize the expanded number of sectors and reformulate the regional models with the adjustments.

The Kirkley approach is similar in terms of data requirements. Fourteen gear type sectors are defined for 12 coastal sub-regions within the Mid-Atlantic region. To use the model, as with the New England model, information is necessary on the value of landings (fishery output) for each sector in each sub-region. Similar to the New England model, the Kirkley approach does not include impacts in restaurants and grocery stores but does account for seafood dealers and processors, so output data for those sectors, by region, is necessary as well. Once the Kirkley model is constructed in spreadsheets, it can be used without knowledge of IMPLAN, and the initial construction of the model requires little knowledge or expertise with IMPLAN. This is in contrast to the approach with the New England model where construction requires a user with a high level of sophistication in using IMPLAN, Microsoft Access, and spreadsheets.

Both the Mid-Atlantic and New England model are similar in that impacts for fishery related sectors are calculated at the multi-state, regional level. Both then allocate the indirect and induced portion of total impacts to sub-regions in proportion to income, employment or output in each sector within the sub-region relative to the larger region. In effect, both consider sub-regions in the analysis, but neither approach represents a truly multi-regional model.

A potential shortcoming of both the New England model and the Mid-Atlantic model relates to the available data to support the modeling application. While no attempt is made here to evaluate the data contained within each model, it appears likely that the level of detail in terms of the number of sectors and regions is greater than can be supported by the available data. For example, for each particular harvesting technology or gear type defined as a sector within the New England model, one sees 11 IMPLAN sectors, one sector for each gear type within each sub-region. For example, the Large Bottom Trawl sector would be defined for Region 1, Region 2, Region 3, etc. until the 11 sectors were completed. Each sub-regional bottom trawl sector could, in theory, have a unique production function and production distribution pattern compared to the bottom trawl sector in other sub-regions.

The estimation of unique sub-regional sectors would suggest that either production expenditures within a particular gear type sector differ across sub-regions or that the distribution of output from the harvesting sector differs across sub-regions. The first appears less likely since harvesting expenditures are determined, for the most part, by the technology employed and seems less likely to vary across sub-regions. Product distribution patterns could vary across sub-regions for a number of reasons: different species taken with the same technology, variations in the location of processing facilities across sub-regions, or variations in the value of sales by sub-regional harvesters to dealers located outside the sub-region. There are likely other possibilities for explaining sub-regional variations, but in any case, the definition of different sectors by sub-region would require both detailed knowledge of the sub-regional industry and sufficient data to specify differences in either harvesting expenditures or product distribution. For a particular gear type sector, to the extent that the production functions and proportional product distributions are the same across sub-regions, the impacts per unit of output value will be the same since the impacts for each sector are assessed within the larger regional model.

One additional difference should be noted between the New England model and the Mid-Atlantic model. The latter is constructed using spreadsheets designed to be used by individuals with little or no knowledge of underlying IMPLAN models. The spreadsheets contain the necessary proportional expenditure and product distribution coefficients, and users are required only to enter the value of landings by gear type sector to calculate impacts. The New England model, on the other hand, is more complex in its application of IMPLAN. There is some possibility of making such a model available to IMPLAN users, but such an effort would require either previous knowledge of IMPLAN or training to develop analysts comfortable with its use. More likely, the New England type model would be developed within a regional center and remain in that center for use by experienced analysts. If widely used, however, the approach of the Mid-Atlantic model would involve some attention to logistics regarding model updates. The IMPLAN data set is updated annually to reflect the latest national and regional data on output, value added, income and employment by sector. If the spreadsheet models were to remain current, then all versions of the models in use would require new multiplier data to be incorporated each year.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations will be discussed at this point with regard to estimating impacts associated with commercial fishing along Florida's east coast. Points offered are based on the assumption that any modeling effort will be comprehensive and ongoing. In other words, the developed model will be applied across all species and harvesting activities in the fisheries for the indefinite future, as opposed to short-term ad hoc efforts to estimate the economic impacts of a specific regulatory change, or a specific component of the fisheries industry. Although this study was focused on Florida's east coast, there are no issues that preclude the application of these conclusions and recommendation to the development of a State-wide fisheries model, given that the necessary data is available and that the modeling approach will be comprehensive.

Adjustments to standard IMPLAN models will be necessary to adequately capture the impact of fishery related industries on Florida's East Coast. Given the large number of species harvested and the variety of technologies (gear types) employed, the fishery sector within the standard IMPLAN regional model will violate the assumptions that a sector produces a homogenous product with a homogenous production technology. Further, due to the same type of variation across regions or sub-regions, the distribution (or allocation) of products from the harvesting sector to other intermediate sectors, domestic and foreign exports, and final consumers is likely to vary widely from that in a regional model based on national averages. The industry is diverse, and that diversity likely rules out the use of generic models that can be used without significant refinements or accommodations to capture its variety.

Given the complexity and time horizon of fisheries regulation programs, the strategy chosen in modeling the economic impacts of regulatory changes must also consider the skill and time required to maintain and update the model, apply the model to different impact questions, and to interpret the results. These modeling capabilities could be implemented using National Marine Fisheries staff or they could be contracted to outside public or private entities. In either case, the key to success is building or acquiring the human capital to carry out development, applications and modification of the I/O models over time. It will also be critical that the analysts working on impact issues be familiar with Florida fisheries, related industries and their regulations, or, have close working relationships with individuals that do.

The final form of the adjusted IMPLAN model will depend on the number of commercial fishery harvest sectors, the number of regions or sub-regions defined within the State, and the number of forward linked industries to be included. These choices will depend on the degree of geographic and sectorial detail desired, and the degree of detail desired in tracing the linkages between fishing related sectors and other sectors of the regional economy. Data requirements for model estimation will increase proportionally as the number of sectors, regions and forward-linkages are added to the model. Specific recommendations on these different aspects of model design are discussed below.

> <u>Based on NMFS's Annual Commercial Landings data for Florida's east coast, seven to ten sectors determined by fishing gear-type or technology would encompass approximately ninety percent of fishery output based on the value of landings.</u> This number, however, must be viewed as a preliminary conclusion. Given the diversity of species landed and the variety of gear types and methods employed, the delineation of additional harvesting sectors will be one of the more challenging aspects of modifying an IMPLAN model to Florida's fishery industry. Certainly, defining sectors is dependent on having (or collecting) the data necessary to specify production functions. The NMFS and the South Atlantic Fisheries Council (SAFC) began collecting cost and effort data on finfish such as snapper, grouper and king or Spanish mackerel in the South Atlantic in 2002. Data collection on shrimp harvesting began in 2004. Cost and effort data for harvesting other economically important species in the South Atlantic, Gulf and Caribbean will presumably follow. These data will be necessary to specify the production functions required to capture the diversity of Florida's fishing industry. The final choice of sectors should come after a thorough review of the data by modeling analysts in consultation with individuals from the pubic and private sectors with detailed knowledge of the fishing industry.

It is feasible to model the regional variation in fish harvesting and post-harvest activity along Florida's east coast using one or more regions. Fishing activity along Florida's east coast tends to be concentrated around three locations. These include the Jacksonville area towards the northern part of the state, the Volusia-Brevard county area near the center of the state, and the Miami-West Palm Beach area to the south. Using geographic sub-regions smaller than the BEA regions would likely result in models that would be less realistic from the standpoint of the fisheries industry and from their inherent economic functionality. The decision will depend on the degree of geographic detail desired, the extent to which forward-linked sectors are to be included, and the degree of detail desired in the ability to trace linkages between fishing related sectors and other sectors of the regional economy. From a geographic perspective, IMPLAN will allow models for areas as small as counties or as large as the entire state or any combination between the two that considers groups of contiguous counties.

A practical alternative to developing a model based on BEA Economic Areas might be to use a state-level model for Florida with seven to ten fishery harvesting sectors based on gear type, in addition to a seafood dealer sector and a seafood processing sector. As noted earlier, expenditures by harvesting sectors are likely to be highly correlated to the technology and may not vary substantially across sub-regions of the state. Thus, production functions estimated at the state level may adequately reflect expenditures at the regional level given a sufficient number of harvesting (gear-type) sectors. This approach could provide a comparable level of sub-regional detail as a model with sub-regions explicitly incorporated into the sectoring scheme. Direct impacts could easily be identified with sub-regions based on estimates of the value of landings for different parts of the state. Indirect and induced components of total impacts could then be proportionally allocated to sub-regions following the procedures used in the Mid-Atlantic and New England models. This alternative regional-sectoring approach would greatly reduce the complexity and data requirements of the modeling effort and therefore the development cost of the model.

Additional and/or adjusted IMPLAN sectors may be required to adequately model the post-harvest seafood industry. Additional information will be required to make reliable decisions on the adjustments and/or extensions needed to model the dealer, broker, processor and/or distributor stages of Florida's seafood industry. A review of existing secondary data can provide an overview of the numbers of firms, approximate sales values, employment and other descriptive information on these sectors. Consultations with industry trade associations and the Florida Division of Seafood Marketing can also provide additional information and contacts that will be useful in initially describing the industry. This information could then be used to develop a series of "focus group" meetings and/or informal interviews with industry members to develop a better understanding of the post-harvest seafood industry. Information derived from these meetings could be used to verify the appropriateness of specifying distinct dealer and processor sectors, and in developing a market-channel survey instrument(s). Multiple survey instruments may needed and may be administered via mail, telephone or personal visits, depending on the nature of the marketing channel, for different forms of seafood products. The survey findings could then be used to specify product movements in more detail with respect to values and to estimate expenditures (production coefficients) for each post-harvest, forward-linked sector specified.

Since input-output models of the type produced by IMPLAN are demand driven, care must be taken to avoid double-counting impacts when forward-linked industries are included in the model. I/O models are ideally suited to the estimation of impacts associated with changes in final demand, where impacts are then traced backwards through the production change to calculate indirect and induced impacts. Regulatory imposed changes in fishing industries, however, usually result in changes in the output of the harvesting sector, the producer of raw product. Such reductions clearly impact the output of forward-linked sectors such as dealers and processors of seafood. Analysts must determine what forward-linked sectors to include, how they can best be incorporated into a model, and how to avoid double counting harvesting output.

Double-counting can avoided by estimating the output changes for the dealer and processor sectors net of the output changes estimated for the harvesting sectors. In other words, the input-output models for the dealer/processor sectors would have to be structured so that the value of the untransformed/unprocessed seafood inputs, (from the fishery harvesting sectors) is excluded from the impact calculations. Within the IMPLAN software, this can effectively be accomplished by setting the regional purchase coefficients for fishery harvesting sector inputs equal to zero. This prevents the model of the post-harvest sectors from purchasing seafood inputs from within the study area and thus subtracts those purchases from the estimated regional impacts.

Data requirements and costs for model development and application will increase with the number of harvesting sectors, sub-regions, and forward-linked sectors added to the model. Increasing the number of harvesting sectors increases the data requirements by the number of sectors included. The analyst will be required to specify production functions or expenditures for each new sector, delineate product flows to forward-linked sectors, and specify interactions between sectors where necessary. The inclusion of additional sub-regions multiplies the data requirements of the model. Data to specify production coefficients and product distribution patterns would be necessary for each sector included in each sub-region. Data will also be needed to represent the interactions between sectors across sub-regions. For each forward-linked sector added to the model, data will be required to specify its production function (just like harvesting sectors). Additional forward-linked sectors will also require information on product flows to other sectors in the marketing channel and to final consumers.

The recommended approach follows that of Steinback and Thunberg in the New England model, but reduces its complexity by focusing on fewer sectors and sub-

regions. This simplified approach will help avoid much of the complex and tedious process of adjusting the national data tables within IMPLAN. This approach is also more feasible in terms of data requirements. If it is decided to model the State as a single region, some degree of geographic specificity could still be achieved though a sub-regional allocation procedure.